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COMPOSTING COTTON GIN WASTE

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INTRODUCTION

Gin waste, also called trash, consists largely of burs, motes, green leaves, particles of stems and leaves, and fine trash. It is bulky, has little or no market value, and may be a fire hazard. This waste usually weighs 8 to 12 pounds per cubic foot when packed by tramping. It has a moisture content of 10 percent or more depending on the content of green leaves.

The chemical composition of gin waste is variable, depending in part on the method of harvest, season of harvest (early, midseason, or late), defoliation, and the soil on which the cotton was grown. Trash used in this study had the following analysis: Ash, 8.05 percent; phosphoric acid (total P_2O_5), 0.34 percent; potassium (K_2O), 2.79 percent; and nitrogen (including nitrates), 1.28 percent.

Gin trash is disposed of by burning, spreading on land, feeding to cattle, and composting. The method used depends in part on rainfall and farm practices in the locality, nearness of homes to the gin, need for the trash, and operational practices of the gin. At most gins, the problem is to dispose of waste by use of a method that is low in fire hazard and in cost of labor.

Burning is not generally recommended, especially in semiarid localities. Smoke and fly ash from trash fires are often a public nuisance, and the burning trash in the gin yard may increase the rates the ginner has to pay for insurance.

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Spreading gin waste on land is a general practice in some cotton producing areas.[2] Trucks have been adapted and are used for dumping waste on fields, for broadcasting loose trash on land, or for placing it in deep furrows. The latter practice is known as vertical mulching. Gin waste is also used as roughage in feed for beef cattle, but its use as feed depends upon the availability and cost of other roughage feeds.[3]

Composting gin waste is practiced to a limited extent in the Southwest.[4] In using this method, ginners can dispose of the waste and provide farmers with valuable soil-conditioning humus. Machine-picked seed cotton contains 120 to 150 pounds of trash per bale; machine-stripped, 600 to 1,000 pounds; and ground cotton (salvage), 1,500 to 2,000 pounds.

The number of gins that provide composting service to their customers is expected to increase in areas having soil that can be improved by the addition of compost. This report is intended to be of assistance to ginners who plan to dispose of gin waste by composting it.

PRELIMINARY STUDIES IN COMPOSTING GIN WASTE

During the 1951-52 ginning season, exploratory studies on composting gin waste were made at the Southwestern Cotton Ginning Research Laboratory, Mesilla Park, N. Mex. In these early tests, 6- x 8-foot enclosures made of wooden slats and of concrete blocks were used as outdoor bins (fig. 1). Oil drums were used as containers in the laboratory (fig. 2).

Bins

The soil under each bin was contoured and then covered with asphalt roofing paper so that drainage could flow into a pit. The bins were then placed over the ground and filled with waste obtained from a saw gin. The waste was tramped in layers about 1 foot thick until the entire bin was filled. Each layer was sprayed with water, and the water that drained off was poured back on the waste.

2/ Harper, Horace J. Cotton burs and cotton bur ash as fertilizer for cotton on a claypan soil. Okla. Agr. Expt. Sta. Bul. B-387, 10 pp. 1952.

3/ Erwin, E. S., and Roubicak, C. B. The use of unprocessed cotton gin trash by growing and fattening steers, Ariz. Agr. Expt. Sta., Univ. of Ariz., Report No. 157 (Processed), 10 pp. Tucson. 1957.

4/ Staffeldt, E. Eliminating diseases in cotton gin waste by composting. Compost Sci. 2: 32-34, illus. 1960.

Figure 1. Bins made of wooden frames and cement blocks were used outdoors in preliminary composting tests.

Figure 2. Oil drums, adapted for aerating compost with compressed air and for tumbling, were used in the laboratory during the preliminary studies. Temperature probe protrudes from the side of the barrel.

Bin No. 1, made of wooden slats, was filled with 2,000 pounds of waste, mainly from hand-picked cotton. Layers of waste were sprayed with water alone. Bin No. 2, also made of wooden slats, was filled in the same way and with the same type of waste but, in addition to having been sprayed with water, was given 40 pounds of commercial nitrogenous fertilizer (44 percent available nitrogen), 80 pounds of commercial fertilizer (0-30-0), and 10 pounds of hydrated lime. Bin No. 3, made of concrete blocks, had the same treatment as did bin No. 2 except that a 0.2 percent solution of Vatsol[5/], a commercial wetting agent, was added.

Under test conditions, the moisture content of the waste ranged from 50 to 60 percent. Samples taken 6 hours after the composting bins were filled showed that trash in the bin to which water and Vatsol had been added contained a higher percentage of moisture than the one to which water alone had been added. After an interval of 60 hours, sampling showed that trash to which water and Vatsol had been added still had the higher moisture content but that the difference between it and the other bin was less than it was after 6 hours.

After the bins were loaded, temperatures were taken of the trash at distances of 6, 30, and 48 inches from the sides of the bin and at depths of 1, 2, and 3 feet from the surface. Temperatures were taken as near as possible at these same points at 1- to 2-day intervals for the first week of composting and at 6- to 8-day intervals thereafter for about 3 months (fig. 3).

A high-velocity cold wind started 5 days after the bins were filled, and temperatures of the composting material dropped at all measuring points. When water was added to restore the moisture lost during the wind, temperatures returned to the previous level.

Moisture was added to the composting trash as needed for decomposition, approximately every other week. Snow and rain that fell during this period affected the moisture content and temperature of the composting material. When moisture was needed, the composting trash was sprinkled evenly until liquid started to drain from the bottom of the bin. About 100 gallons of water was applied each time the trash needed moisture.

Throughout the entire composting period, temperatures varied when the weather changed. The temperature of the compost in the cement block enclosure was more stable than that of the bins, doubtless because of the insulation provided by the block walls.

5/ Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

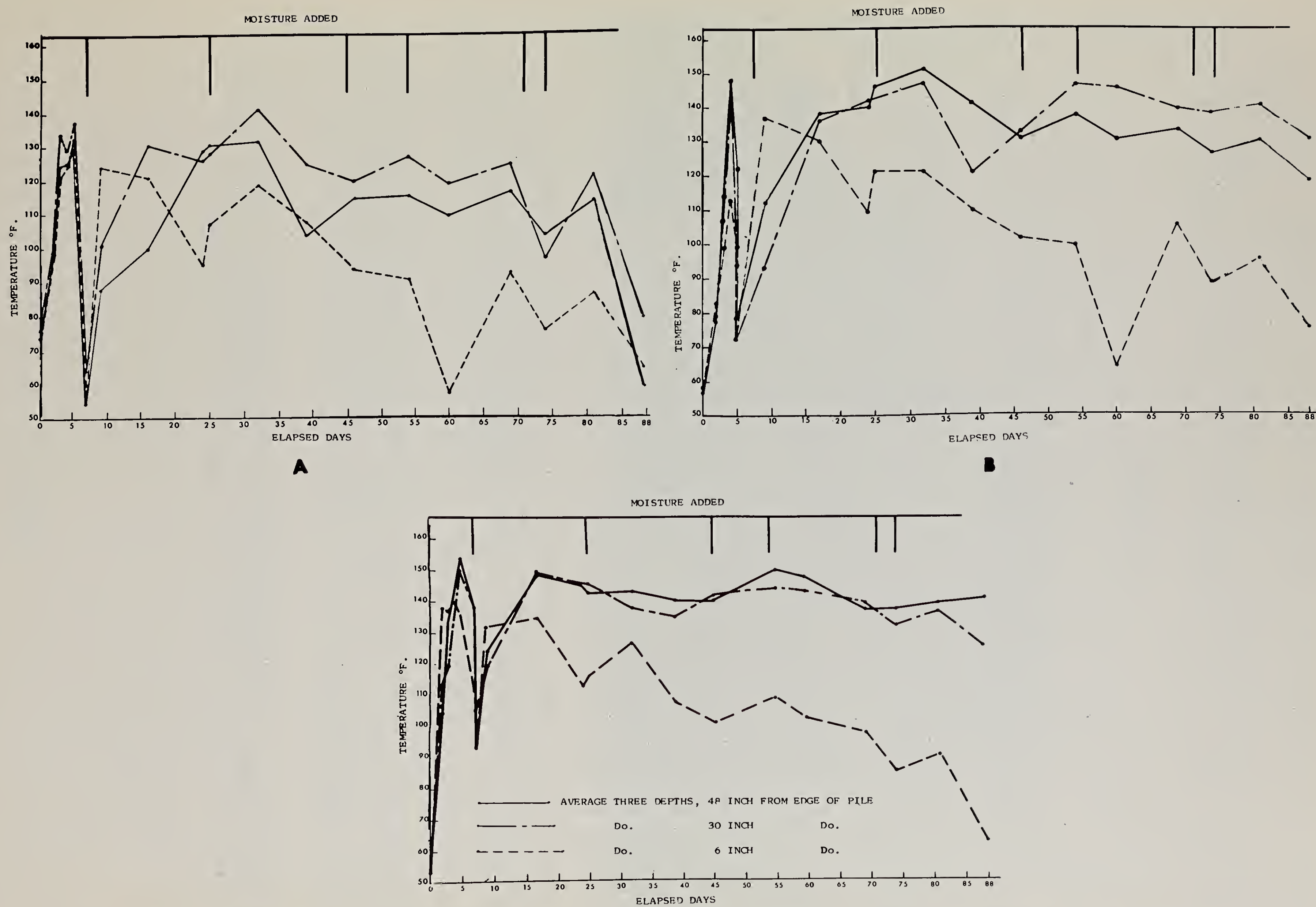

Figure 3. Temperature variations of gin trash composting at three distances from side of bin in (A) bin No. 1; (B) bin No. 2; and (C) bin No. 3.

Decomposition (composting) of the gin waste occurred under the test conditions, but it was far from complete at the end of 3 months. There were no differences in the rate of composting in the several bins that could be attributed to the wetting agent or to the chemical fertilizers. There was some indication, however, that exposure of the wet material to ambient air speeded the composting process.

Oil Drums

Oil drums were adapted for use as compost containers by cutting out one end and hinging it to the sides to facilitate filling, and by providing an air-hose connection so that the composting trash could be aerated by use of compressed air (fig. 2). Gin trash comparable to that used in the outdoor bins was obtained for tests in which oil drums were used.

Moisture was added by soaking the trash in a 0.2 percent Vatsol solution. This treatment increased the moisture content from about 10 percent to 70 or 75 percent. They spray method used in the bin tests previously described provided trash with a moisture content of 50 to 60 percent. Another difference between the two types of tests was that the bin tests were made during the winter and those utilizing the oil drums during the summer when ambient air conditions were perhaps more favorable for decomposition of the trash.

In tests that utilized oil drums as containers, trash was treated in three general ways: (1) Soaking in a 0.2 percent Vatsol solution for an hour, draining, and allowing trash to compost with no subsequent treatment; (2) same initial treatment as described for 1 but aerating periodically with compressed air; and (3) same initial treatment as described for 1 but aerating by turning the drum slowly a few minutes each day.

At the end of 21 days, an estimated 60 to 70 percent of the decomposition had occurred in trash that had been only soaked with water containing 0.2 percent of Vatsol. Trash exposed to the atmosphere at the ends of the drum was more completely decomposed than that elsewhere in the drum. This indicated that exposing trash to ambient air was helpful in attaining rapid decomposition.

Decomposition of trash was uneven in the drum aerated with compressed air. Channels developed in the trash, and air did not move uniformly throughout the mass. Apparently, drying had occurred along these channels when the air moved at a high velocity.

An estimated 80 to 90 percent decomposition occurred in 21 days in the drum that was rotated slowly twice a day. The stirring action that resulted when the drum was rotated allowed air to reach all the wet trash.

TREATMENTS TO HASTEN DECOMPOSITION OF GIN TRASH

The results of decomposing gin waste in the preliminary studies showed that the methods used were too slow to be of practical value to ginners. Consequently, additional studies were performed during the 1952-53 ginning season to develop faster ways of decomposing this waste. A group of six composting piles of trash were built. Each pile contained about 1,700 pounds of trash, and the trash for each pile was spray-wetted with a 0.2 percent Vatsol solution when transferred from gin trailer to truck for hauling to composting site (fig. 4). The trash was sprayed again as the piles were formed. By use of

Figure 4. Spraying gin trash for compost during handling.

this method of spraying, the moisture content of the trash was increased from about 10 percent to 70 - 75 percent.

Five of the piles were placed in enclosures approximately 4 feet deep, 6 feet wide, and 8 feet long. The sixth pile was built in the open, and the trash for this one was placed on building paper and not confined to an enclosure. The soil under each pile was contoured and covered with building paper, so that drainage from the pile could be collected and poured back on the trash (fig. 5).

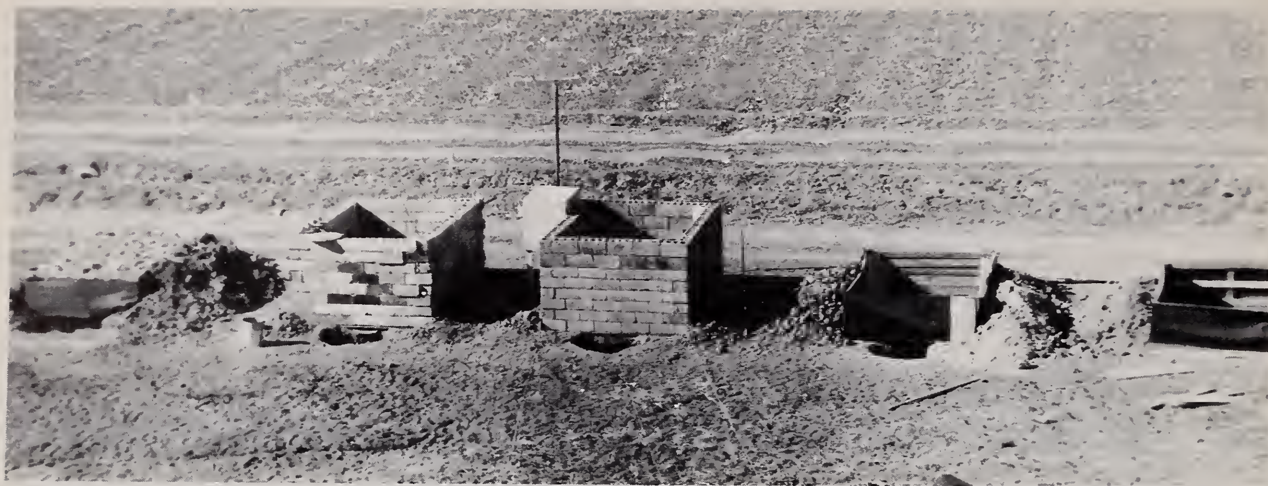

Figure 5. Compost bins under construction for the study of treatments to hasten the decomposition of gin trash.

Types of Enclosures Used

The sides and ends of the three pit-type enclosures, or bins, were made of wooden frames that extended 2 feet above the ground line. The sides of these frames were lined with building paper. In one pit-type enclosure, tunnels made of boards were placed diagonally across the bottom and were connected to vertical vents built in the bin corners to provide natural ventilation.

Two cinder-block enclosures each with their floor at ground level were also built. Ventilators comparable to those used in one pit-type bin were installed in one of the cinder-block enclosures (fig. 6).

Aeration and Decomposition

An estimated 40 to 50 percent of the decomposition had occurred at the end of 21 days in the pit-type bin that had no aeration. However, 60 to 70 percent of the decomposition had occurred in the pit-type enclosure equipped with tunnels for natural ventilation (table 1). There was some difference in the initial moisture content of the trash in favor of that in the bin having the ventilators. Approximately 75 to 85 percent of the decomposition had occurred during the same 21-day period in the pile that was aerated by turning by hand with a fork. The greater degree of decomposition in favor of hand turning doubtless can be attributed to the fact that hand turning provided more aeration than the method in which pit tunnels and vents were used.

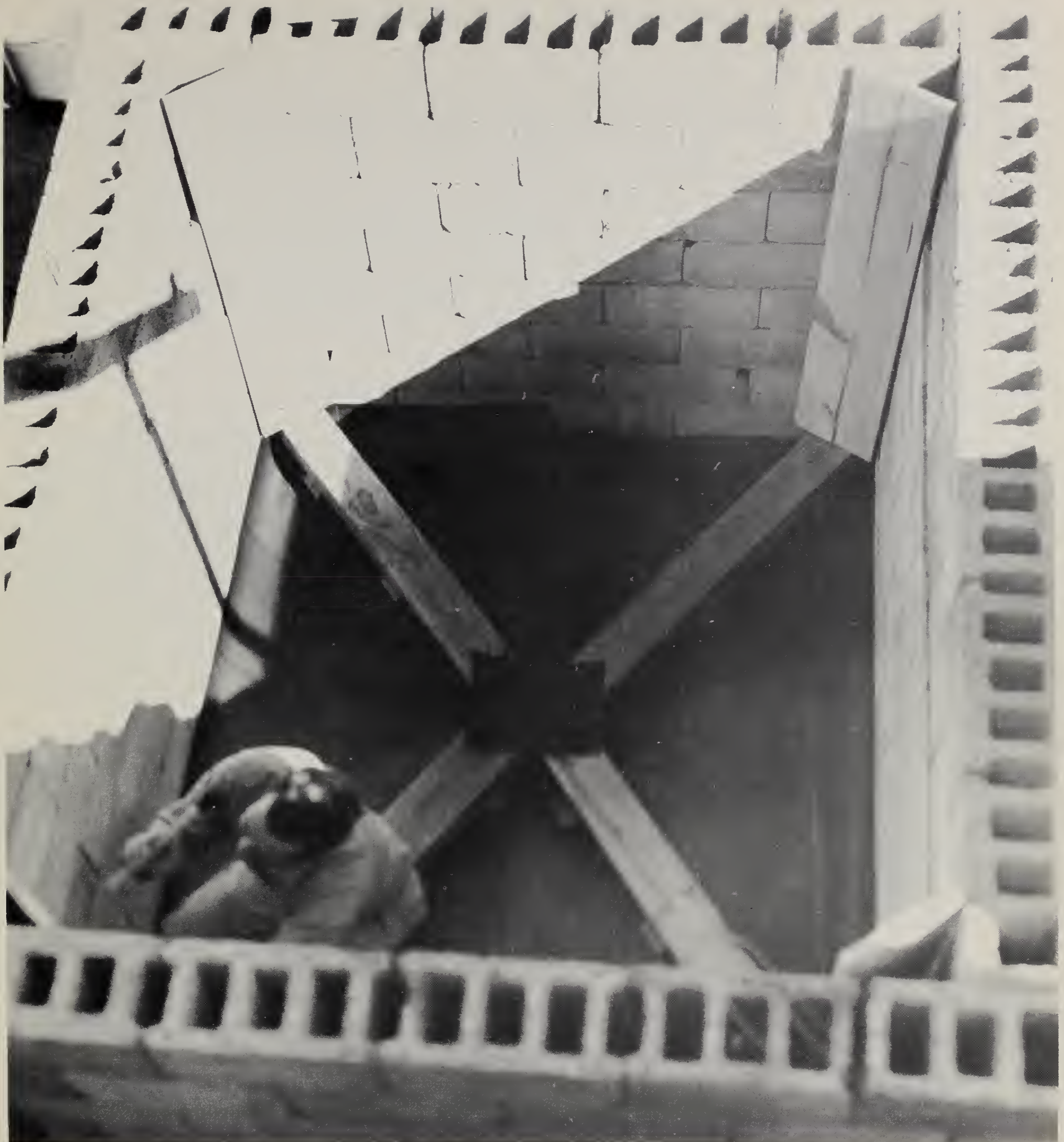

Figure 6. Cinder-block enclosure showing diagonal tunnels along bottom and vertical ventilators at each corner to provide natural ventilation of composting gin trash.

Table 1. Some effects of aeration, commercial fertilizer, and bacterial culture on decomposition of gin waste

Test pile enclosure and number	Moisture content after wetting	Aeration	Added ingredients	Temperature before leveling off	Time elapsed from beginning	Maximum temperature	Time elapsed from beginning	Temperature drop from leveling off until the end of 21 days	Estimated decomposition after 21 days
	Percent			° F.	Days	° F.	Days	° F	Percent
Pit, 1-----	70.3	None	None	126.2	8	126.2	8	7.0	40 to 50
Pit, 2-----	75.2	Wooden tunnels	None	142.2	10	143.0	14	6.5	60 to 70
Cinder block, 3-------	75.9	None	Aero Cyanamid	156.6	9	156.6	9	14.1	65 to 75
Cinder block, 4-------	75.5	Wooden tunnels	Aero Cyanamid	156.5	8	158.5	18	5.5	65 to 75
Pit, 5------	76.6	None	Bacterial culture	134.3	11	135.2	15	9.8	40 to 50
Not enclosed, 6-------	72.6	Turned by hand	None	153.8	3	159.7	5	56.2 1/	75 to 85

1/ Cooled during hand turning.

Fertilizer and Decomposition

One hundred pounds of commercial fertilizer containing 50.5 percent Aero Cyanamid and 49.5 percent inert matter was sprinkled uniformly through the trash as both cinder-block bins were filled. The compost in one of these bins was aerated by natural draft through tunnels previously described. No ventilation was provided for the other bin. The decomposition at the end of 3 weeks was the same in both bins--65 to 75 percent (table 1). Because of differences in bin construction and moisture content of the trash, no conclusions can be drawn between the fertilizer treatment and other treatments in this series. However, the data indicate that chemical fertilizers were beneficial in composting gin waste under the test conditions.

Bacterial Culture and Decomposition

Trash for the bacterial culture test was spray-wetted with a 0.2 percent Vatsol solution in the same manner as for other tests in this series. A pit-type bin without ventilators was used for the bacterial culture test, and the prepared inoculant was sprinkled evenly through the trash as the bin was filled. At the end of 21 days, an estimated 40 to 50 percent of the trash had decomposed. Practically the same results were obtained under comparable conditions in pit No. 1 to which no bacterial culture had been added (table 1).

TREATMENTS TO KILL CROP PESTS IN GIN WASTE

Pink Bollworm and Weed Seed

Studies by the Southwestern Cotton Ginning Research Laboratory, Mesilla Park, N. Mex., show that few pink bollworms brought to modern gins in seed cotton survive the ginning process.[6] Observations and preliminary tests also indicate that few weed seeds retain their viability in compost piles.

Verticillium Wilt

The possibility of spreading Verticillium wilt in composting waste posed a problem. Four test piles of waste were established during the 1952-53 ginning season to determine if Verticillium wilt could survive during the composting of gin trash. These tests included the use of commercial composting inoculents and of selected fungi.

6/ Robertson, O. T., Stedronsky, V. L., and Currie, D. M. Kill of pink bollworm in the cotton gin and the oil mill. U.S. Dept. Agr. Prod. Res. Report No. 26, 22 pp., illus. 1959.

Pits were dug approximately 2 feet deep, 6 feet wide, and 8 feet long, and the sides were extended 2 feet above the ground by use of slatted fence. Dirt was piled against the fence from the outside. A slatted raised floor was placed in the bottom of each pit or bin. Air vents were provided at the four corners and in the center for natural ventilation of the space below the slatted floor (fig. 7).

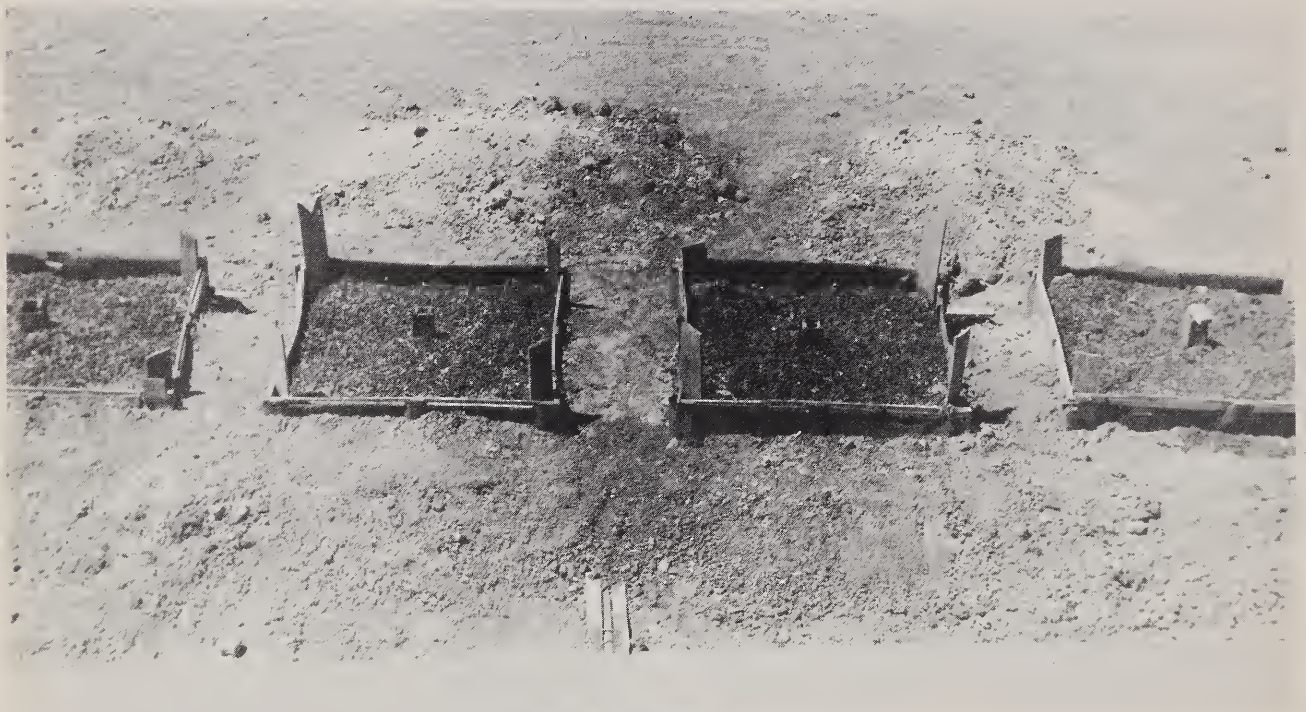

Figure 7. Pit bins partly filled with gin trash showing vents in corners and center for natural ventilation of space below slatted floor.

The trash was thoroughly spray wetted in handling as described for previous tests, and it was sprayed again when placed in the bins. Wetting agents were not used because their effects on cultures and fungi are not known.

Bin No. 1, the control or check, carried a full component of Verticillium wilt samples but no other additives. Bins No. 2 and 4 contained commercial composting inoculants known as Fertosan and Soil Biotics in addition to wilt samples. Bin No. 3 contained wilt samples and isolates of fungi known to be effective against the normal development of V. alboatrum.

Small portions of cotton stalks infested by hand with Verticillium wilt were placed in each of the four piles of trash in the bins. These pieces of stalk were attached to wires, six pieces to a wire and each piece spaced 6 inches apart on the wire. Six wires of wilt specimens were placed in each bin. Wires were spread over the trash 2 feet from the bottoms as the bins were filled. One wire was placed across each quarter segment and two wires across the middle.

Internal temperatures of the trash in these bins over a period of 40 days are shown in figure 8.

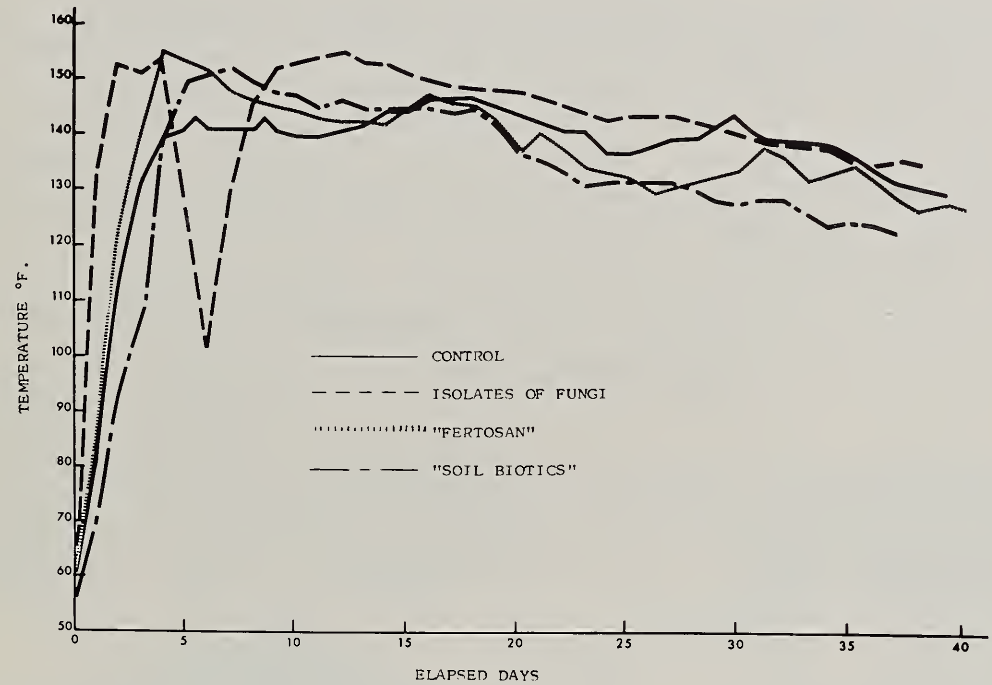

Figure 8. Bin temperature of gin trash compost as affected by isolates of fungi and of commercial composting inoculants.

Two wires of the wilt specimens were removed from each of the four bins at the end of 2 weeks. Three pieces of stalk tissue were taken from each of the 48 pieces of stalk removed and were planted in culture from which no Verticillium wilt organisms developed. At the same time, nine isolations were made from three pieces of stalk maintained in the laboratory for check purposes. Verticillium wilt developed from each of these check samples.

At the end of 40 days the remaining wilt specimens, or wires, were removed from the compost piles. The specimen were examined, and no Verticillium wilt could be found.

Fungi and Bacterial Culture

The temperature of the compost in the two bins treated with bacterial culture rose at a slightly faster rate than that in the control bin. In addition, these bins attained a higher temperature during the first 10 days. Thereafter, there was no significant difference in the internal temperature of the three bins.

The temperature rose more rapidly in the compost inoculated with fungi than it did in the other bins. It reached 152° F. in 48 hours. It fluctuated to a low of 100° F. at the end of the fourth day, to a high of 150° F. at the end of the twelfth day, and then followed the pattern and range of the temperature in the other bins (fig. 8). After reaching a maximum, the compost temperature remained relatively stable in the range of 140° to 150° F. for the first 15 days. It then began a steady decline to 125-135° F. at the end of 40 days (fig. 8 and table 2).

Table 2. Some effects of cultures on the temperature of decomposing gin waste

Test bin number	Average moisture content after wetting	Additive	Temperature attained on initial rise	Initial maximum temperature reached in--	Variation in temperature from maximum to end of 21 days
	Percent		Degrees F.	Days	Degrees F.
1------	78.9	None (control)	155	4	18
2------	78.2	Fertosan 1/ -----	140	4	10
3------	74.6	Fungi 2/ --------	153	2 3/	55 4/
4------	76.9	Soil Biotics 1/	153	6 1/2	18

1/ Commercial composting culture.
2/ Fungi affective against normal development of *V. alboatrum*.
3/ Rapid rise due to fungi.
4/ Wide variation caused by decline from 159° to 100° F. between the fourth and sixth days. Actual variation other than this erratic decline was approximately 10° F. See figure 8.

The erratic rise and fall of temperatures in the bin No. 3, which was seeded with fungi, is attributed to the nature of the microorganism used. The organisms were very active at first and brought about the rapid rise in temperature. They were not thermophylic, however, and the high temperatures killed them. Consequently, the temperature of the composting waste declined. The microorganisms originally added were replaced apparently by others that were suited to the higher temperatures. None of the six fungi originally introduced in the trash could be found in the compost at the end of the test.

COMPOSTING AT GINS

Pit silos and surface enclosures have been used at gins for composting gin trash. The pits are similar to those used for storing ensilage. Building blocks or boards have been used for the walls of enclosures built on the surface of the ground. A compost pile enclosed on three sides by adobe walls is shown in figure 9.

Waste from the pneumatic handling system at the gin is directed into the enclosure and sprayed with water. However, the trash usually needs water in addition to the initial spray. Approximately 3.5 pounds of water are needed per pound of trash to increase its moisture content from about 10 percent to 70 - 75 percent. Water in addition to the initial spray is usually added as the compost pile builds up during the ginning season.

Figure 9. Ground-level gin compost bin enclosed on three sides by adobe walls. Pipe for water spray is on top of last few sections of trash blower pipe.

In the Mesilla Valley of New Mexico usable compost has been obtained at gins in about 3 months. Tractor-mounted manure forks are used for emptying the enclosure and loading the compost on trucks.

CONCLUSIONS

1. Microorganisms that are active in decomposing gin trash require water and oxygen from rapid development.

2. The organisms needed for composting are present in gin trash, and no starter or inoculant is necessary.

3. Test results were not conclusive regarding the value of chemical fertilizers in hastening decomposition of gin trash. Such added ingredients would, however, increase the value of the compost.

4. A moisture content of 70 to 75 percent is desirable for composting gin trash and can be obtained by repeated spraying or by soaking the trash in water.

5. Usable compost can be produced in about 3 weeks if the trash is aerated and kept wet.

6. Gin trash placed in pit silos or ground-surface enclosures with no aeration but thoroughly watered will decompose sufficiently for use in about 3 months.

7. The temperature of decomposing gin trash under semi-aerobic conditions depends in part on the moisture content of the trash, size of the pile, nature of enclosure, additive, and ambient conditions.

8. Composting of gin trash following the ginning operation destroys Verticillium wilt organisms and possibly the viability of most weed seeds.